Oct. 11, 1960 J. SEJOURNET 2,955,709

HOT EXTRUSION OF METALS

Filed June 10, 1953

Fig.1

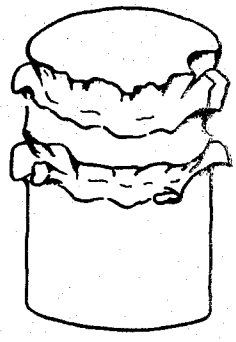


Fig.2

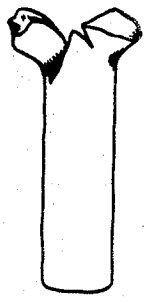


Fig.3

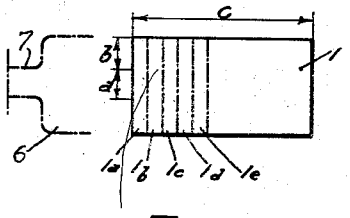


Fig.4

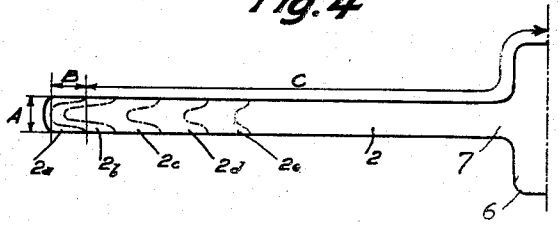


Fig.6

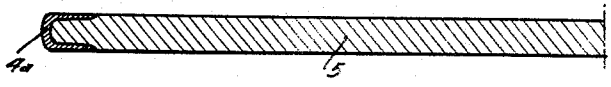
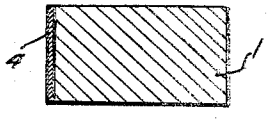


Fig.5



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HOT EXTRUSION OF METALS

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6 Claims. (Cl. 207—10)

The present invention concerns the hot extrusion of metals, which is generally effected by means of hydraulic presses comprising essentially a container in which the metal billet to be transformed is placed, a die which fits at one end of this container and the orifice of which represents the cross section of the part which it is desired to obtain by extrusion, and a punch which enters the container and presses on the end of the billet opposite that facing the die and transmits to said billet the force developed by the press, so as to force the metal of the billet through the die.

The great number of the metals and alloys submitted to such a press extrusion process do not in general present surface faults. Metals and alloys, however, of poorly ductile nature or of bad homogeneity and more particularly difficult to extrude, provide such faults after extrusion.

One of these faults is constituted by cracks, localized at the front end of the extruded bar, which may be circular cracks, of the so-called "palm tree" type, or spreading cracks, the latter occurring generally in products extruded from cast billets.

Amongst the alloys which produce faults of this type, there may be mentioned, for instance high speed steels of the 18–4–1 type (C=0.8, W=18, Cr=4, V=1), refractory steels of the American type S.816 (C=0.36, Mn=1.5, Cr=20, Ni=20, Co=41, W=4, Mo=3.7, Cb=4, Fe=4); Silicon bronze (copper 97, silicon 3).

The presence of these faults makes it necessary to pare off the front ends of the extruded bars, which constitutes a serious economic disadvantage as in general the metals or alloys dealt with are costly.

An object of the present invention is to provide a process which makes it possible to avoid in a practically total manner, the formation of the faults above referred to, and to decrease in an important proportion the length of the portion to be pared off at the front ends of the extruded bars.

Said process consists, essentially, in placing, between the billet of metal to be extruded and the bottom of the extrusion press container, an auxiliary part, for instance a disc of a simple metal or of an alloy different from that constituting the billet and covering substantially the entire area of the end of the billet, the nature and properties of the metal forming said part being selected by experience, as being capable of preventing the formation of undesirable faults.

The thickness of the metal disc thus placed in front of the billet should be fairly high, for instance on the order of 5 to 50% of its diameter. It may be either secured by any known means, such as welding, for instance, on the front of the billet, before extrusion, or previously placed in the bottom of the container.

When extrusion takes place under such conditions, the disc is deformed at the beginning of the extrusion and covers the first portion of the extruded bar, thus preventing the formation of the above mentioned cracks. After extrusion it is then sufficient to separate said portion of the bar, which is thus covered, and which is very substantially shorter than that on which the cracks would have occured in the case of a direct extrusion of the billet, without interposing of the disc according to the process of the present invention.

The explanation of this result, as well as more precise details as to the manner of carrying out the invention are given hereinafter with reference to the appended drawing wherein:

Figure 1 is a perspective view of the end of an extruded cylindrical bar having so-called "palm tree" cracks:

Figure 2 is a similar view of a bar having spreading or flaring cracks.

Figure 3 is a diagrammatic view, showing a billet **1** and a container **6** for the billet, before the billet has been placed in the container, the billet being shown as divided into imaginary slices **1***a*—**1***e*.

Figure 4 is a diagrammatic view, showing the billet **1** partially extruded into the bar **2**.

Figure 5 is a view in diametral section of a billet provided with a disc according to the invention.

Figure 6 is a similar view of the front end of an extruded bar, according to the invention, made from the billet of Figure 5.

As indicated above, during the extruding of some metals and alloys which have poor ductility or which are lacking in homogeneity, there may occur, at the front end of the extruded bar, "palm tree" type cracks (see Figure 1) or flared cracks (see Figure 2).

The occurrence of these faults is due to the fact that, particularly at the beginning of an extruding operation which tends to deform a billet **1** (Figure 3), by extrusion through the die **7** into a bar **2** (Figure 4), the imaginary parallel slices **1***a*—**1***e* of the billet **1** are deformed into shapes **2***a*—**2***e* which nest into one another as shown in Figure 4. The central portion *a* (Figure 3) of the front face of the billet, corresponding to the cross section of the die is punched by the latter and becomes, after extrusion, a slightly bulging surface A (Figure 4). The remainder of the front face of the billet, or annular surface *b* (Figure 3) covers the first portion of the extruded bar at B (Figure 4). The cylindrical surface *c* (Figure 3) of the billet becomes, after extrusion, the remainder C (Figure 4) of the extruded bar. The surface *a* undergoes practically no superficial deformation, the surface *c* undergoes a practically constant deformation from one to the other end of the billet, and the surface *b* undergoes a very important increasing superficial deformation. These differences in deformation and the swaging of the various slices on one another, entail the production, in the head portion of the extruded bar, of tensions which, in extruding metals or alloys, steels, for instance, poorly ductile or not sufficiently homogeneous, cause the formation of the above mentioned faults, and the entire portion of the bar which offers such faults has to be cut-off and rejected.

To prevent the economic consequences of this phenomenon of cracks, according to the invention a disc **4** is placed in front of the billet **1** (Figure 5). This disc is made of a metal or alloy which, during extrusion, does not cause the formation of said faults, said disc being attached to the billet, by welding for instance.

During extrusion, the disc **4** is subjected to a deformation similar to that undergone, in the case of Figures 3 and 4, by the slice **1***a* of the billet **1** and covers at **4***a* (Figure 6), the front end of the bar **5** extruded from the billet **1**, preventing the formation of faults. It is then sufficient to cut-off the portion of the bar **5** which is covered by the deformed disc **4***a*, while in the case of Figure 4, it is often necessary to reject the whole end of the extruded bar, up to the slice **2***e*.

Instead of being connected with the billet **1** before extrusion, and therefore heated to the same temperature as the billet, the disc 4 may be placed at the bottom of the extrusion press container, before introducing the billet. It is then possible to heat the disc either to the same temperature as the billet, or to a different temperature, which makes it possible if necessary, to adjust the resistance to deformation of the metal constituting the disc to that of the metal constituting the billet.

A metal is generally used, for the disc, offering a lower resistance to deformation than that of the billet at the same temperature. This results in a new advantage, i.e. decreasing the extrusion pressure at the start, and therefore increasing the possibilities of deformation.

Thus for extruding a high speed steel such as above referred to, a carbon steel disc may be used, and for extruding silicon bronze, an ordinary bronze disc.

Experience has shown that the process according to the invention gives all the better results as the tool lubrication is itself more thorough in operation. It is therefore recommended to apply this process with a suitable lubrication, and more particularly by using as lubricant, a product which can melt in contact with the billet or the tool at the operation temperature, while remaining viscous, and especially glass.

When the disc and billet are at different temperatures, it may be suitable to adjust the lubricant to the temperature, therefore to use a juxtaposition of glasses having substantially the same viscosity, one at the temperature of the disc and the other one at the temperature of the metal to be extruded. The amounts of these two lubricants should, of course, be adjusted to the relative sizes of the two surfaces of different natures to be lubricated.

The following examples illustrate various practical embodiments of the process of the invention.

Example 1.—The extrusion was effected, in a container having a diameter of 140 mm., with a 1500 ton press, on billets of S.816 steel, 130 mm. in diameter and 300 mm. long, into round bars 35 mm. in diameter.

Effecting the extrusion in the usual manner, after raising the billet to a temperature of 1220° C., and lubricating with a glass wool plug, a formation was found of "palm tree" type cracks (Figure 1) over a length of the extruded bars, reaching 0.50 m.

When on the contrary and according to the invention, a steel disc (0.1 carbon) and 30 mm. thick was welded in front of the billet, by operating under the same conditions of temperature and lubrication, faultless bars were obtained, a 50 mm. length of which merely was covered by the deformed disc, as shown in Figure 6. The metal of the disc was easily separated from that of the bar.

Example 2.—In a container 148 mm. in diameter, with a 1500 ton press, billets of pure molybdenum, 140 mm. in diameter and 450 mm. long, were extruded into round bars 80 mm. in diameter.

Proceeding with the extrusion in the usual manner, after raising the billet to a temperature of 1350° C., and

lubricating by means of Pyrex glass, the formation of flared cracks was found over an extruded length reaching to 0.10 m.

If, on the contrary, a few seconds before introducing the billet, a steel disc (0.1 carbon) was introduced into the container, 60 mm. thick and raised to a temperature of 1100° C. using as a lubricant glass wool placed between the Pyrex glass and the disc, faultless bars were obtained on which a length of a few centimeters only was covered by the deformed disc.

What I claim is:

1. In a method of extruding a heated solid metal billet through a die to form a solid bar, the steps comprising interposing between the leading end face of the billet and the die, prior to extrusion, an auxiliary metal part covering substantially the entire area of said leading end face, the auxiliary metal part and the billet, at the temperature employed for each of them, being such that the auxiliary metal part offers a lower resistance to deformation than the billet, said auxiliary metal part being of such thickness that it forms only a short cap on the front end of the bar extruded from the billet, extruding all of said auxiliary metal part and all but a small portion of the billet through the die, the billet having such poor ductility at the extrusion temperature employed that the front end of the extruded bar would crack if said auxiliary metal part were not employed, and severing the front end portion of the extruded bar covered by said cap from the remainder of said extruded bar.

2. A method according to claim 1, wherein the metal of the billet is high speed steel.

3. A method according to claim 1, wherein the metal of the billet is high speed steel and said auxiliary metal part is low carbon steel.

4. A method according to claim 1, wherein the metal of the billet is refractory steel.

5. A method according to claim 1, wherein the metal of the billet is refractory steel and said auxiliary metal part is low carbon steel.

6. A method according to claim 1, wherein the metal of the billet is silicon bronze and wherein said auxiliary metal part is bronze of a character which offers a lower resistance to deformation than the silicon bronze at the temperatures of the billet and auxiliary metal part.

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